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Physikalisches Kolloquium — Physics Colloquium

Einladung — **Invitation**

Monday, 14 December 2020

Format: Online via Webex, at 16:15

Don't average!

Learning from fluctuations in diffusive processes

Prof. Dr. Ralf Metzler

Chair for Theoretical Physics,
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GROUP

After a brief introduction to the history of Brownian motion, I will address current challenges to the physical understanding of diffusive processes in complex systems. These challenges arise from modern experimental techniques such as single particle tracking as well as supercomputing studies. Typically, these approaches provide time series from relatively few trajectories of tracer particles, of finite measurement time. Evaluating individual trajectories, for instance, in terms of time-averaged mean squared displacements, the results will naturally fluctuate from one trajectory to another. Instead of averaging further over all measured trajectories, I will argue that one can extract valuable information from these fluctuations, helping us to decipher the physical mechanisms behind the observed particle motion, including measurement noise. For both normal and anomalous diffusion, the exact form of these fluctuations will be discussed for measured moments as well as the single-trajectory power spectrum. Moreover, the emergence of non-Gaussian forms of the displacement distribution due to inhomogeneous environments will be addressed. In a similar spirit I will argue that cognisance of the entire distribution of reaction times is vital for the understanding of low-concentration chemical reactions, rather than focusing on mean reaction rates. Finally, current data science approaches to the analysis of diffusing data are introduced in terms of Bayesian and machine learning techniques.

Host: Prof. Dr. Joachim Ankerhold, Institute of Complexe Quantum Systems

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